Fire in a Changing Climate

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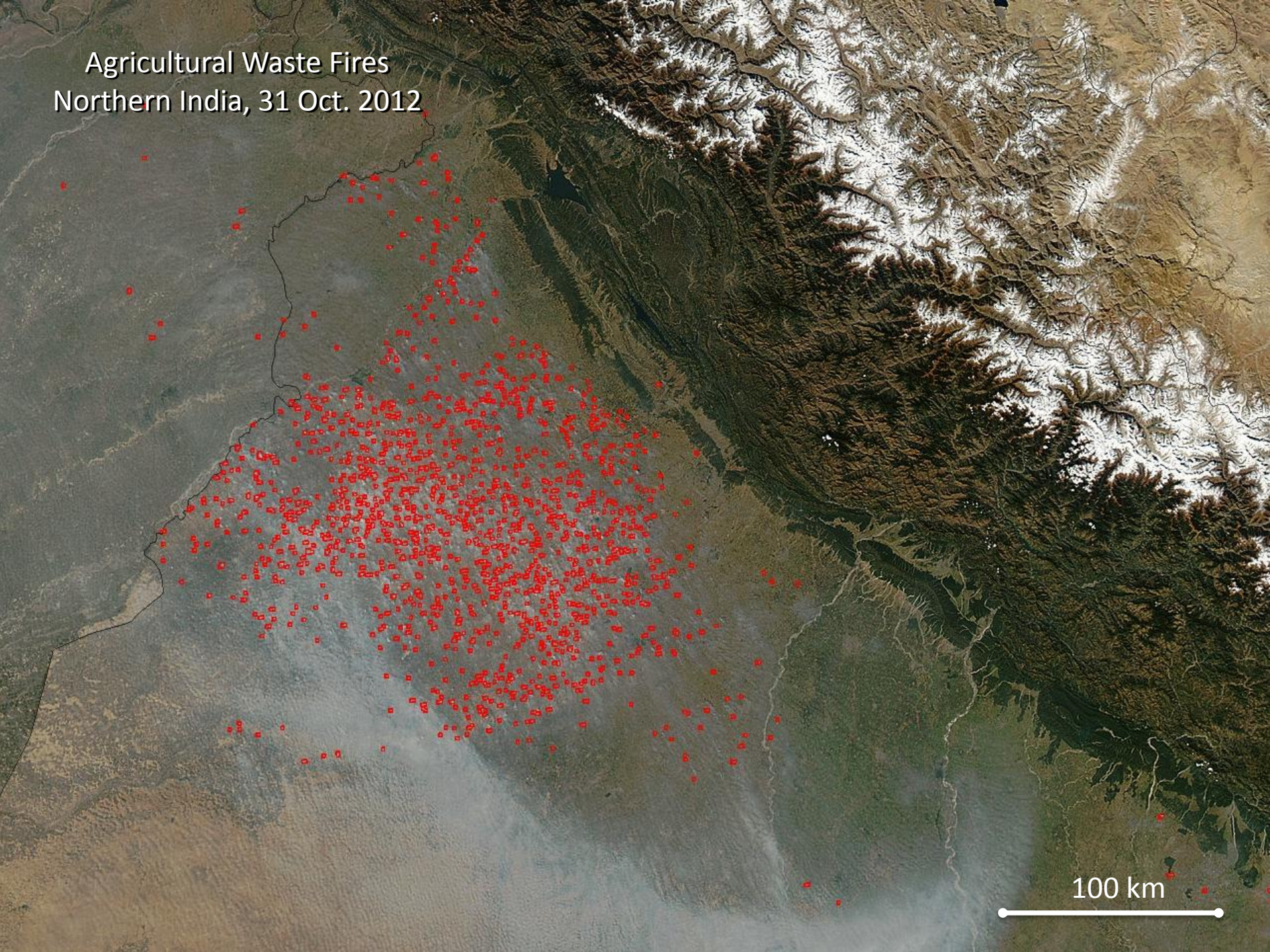
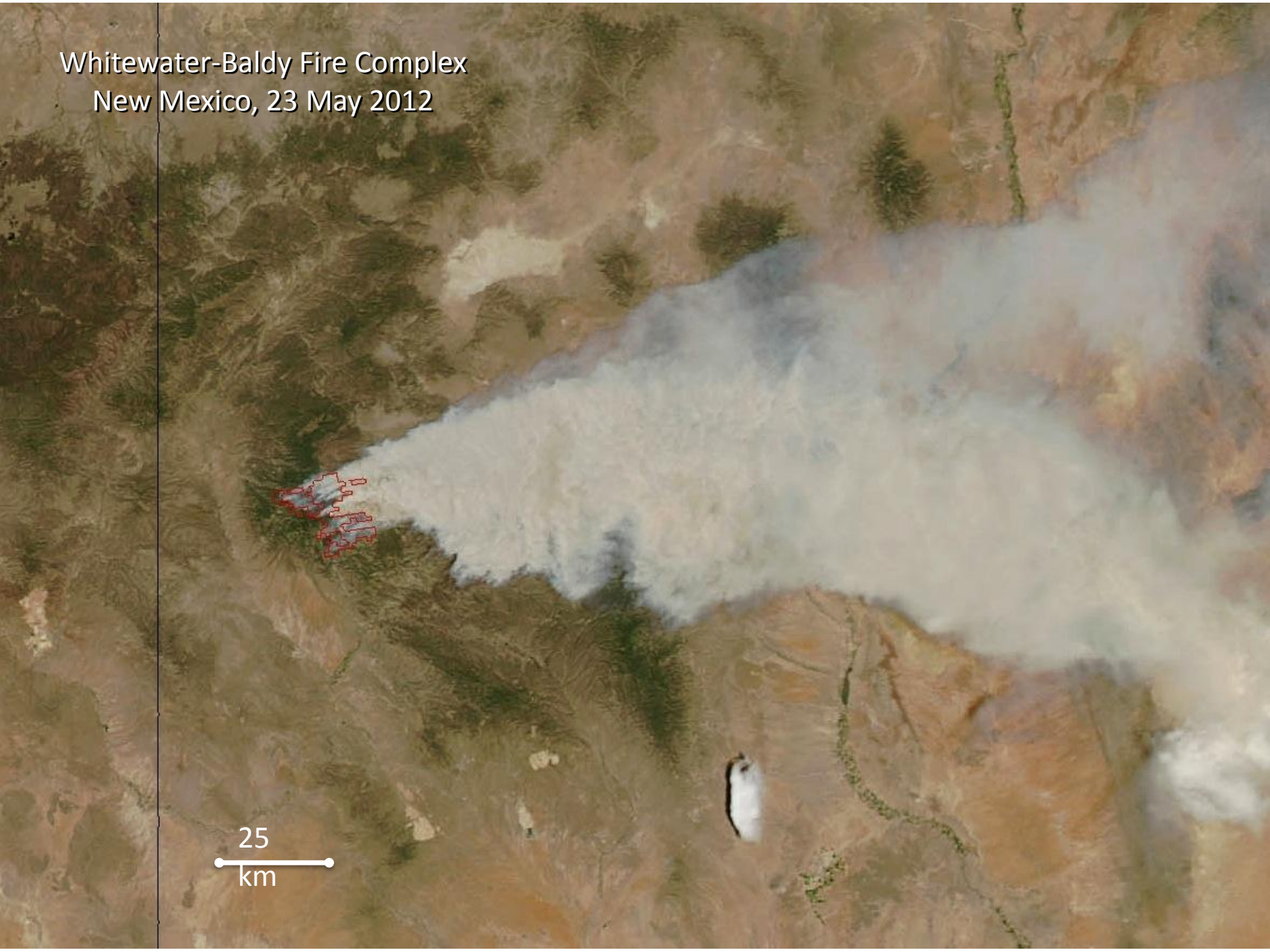
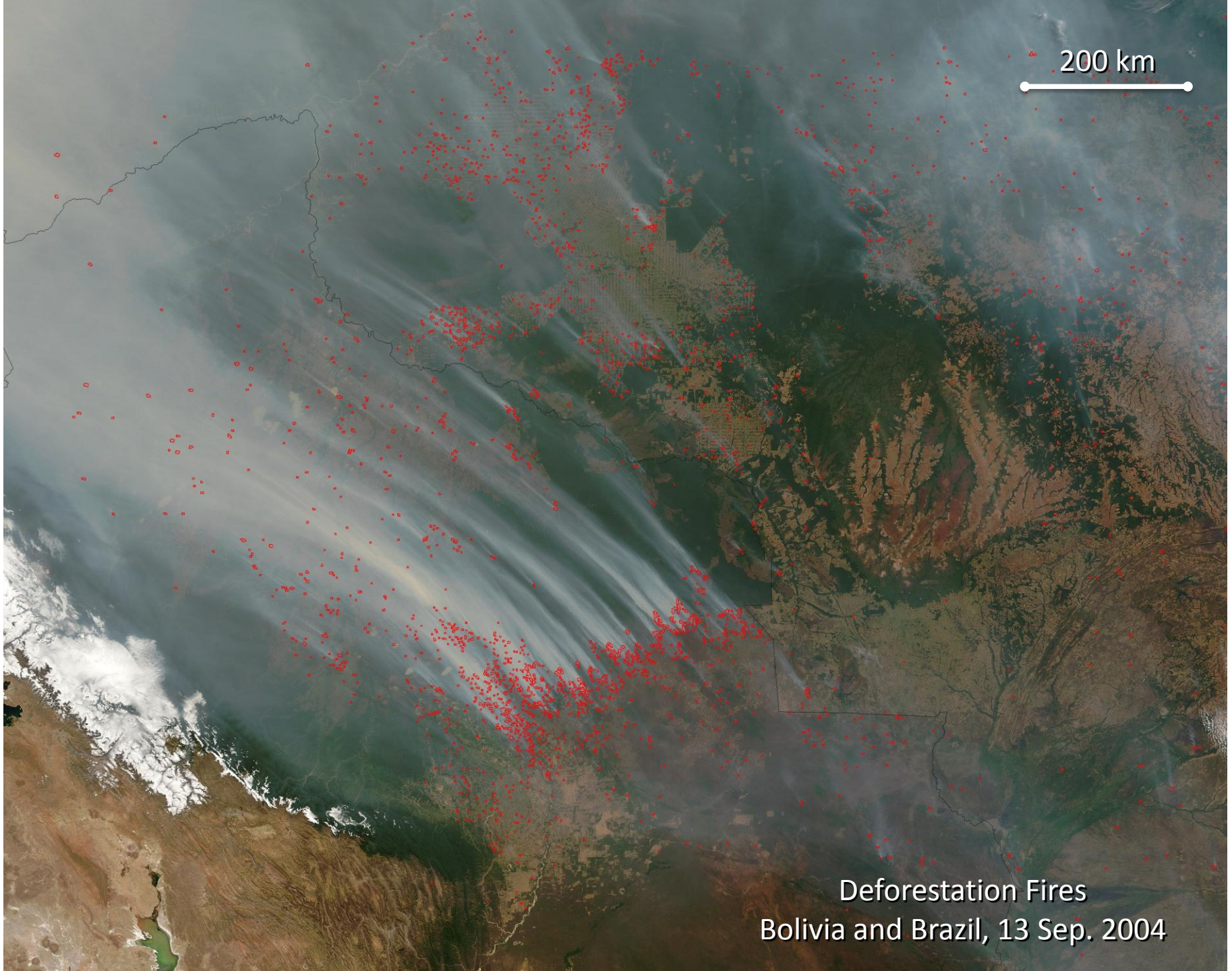
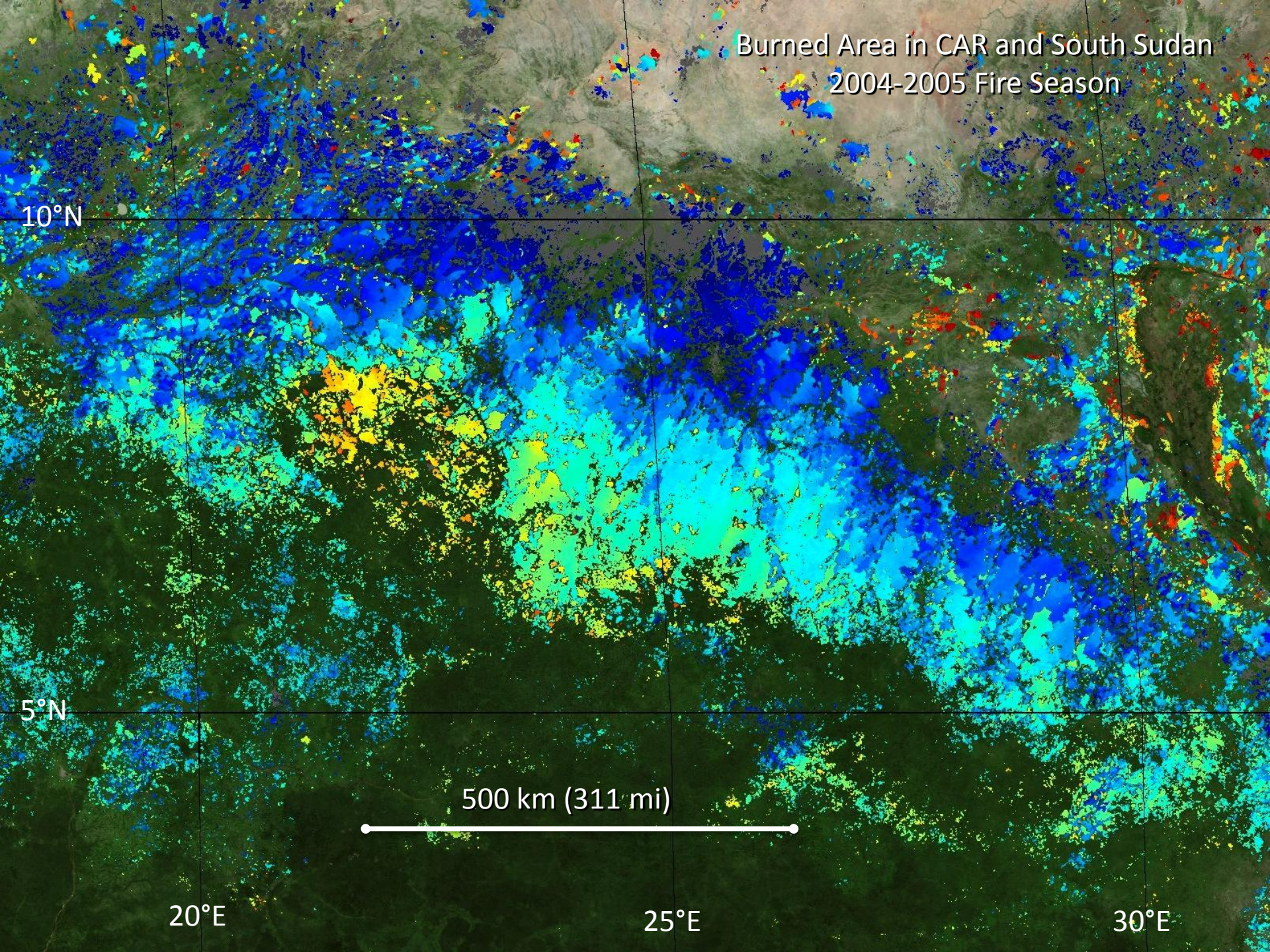

Agricultural Waste Fires
Northern India, 31 Oct. 2012
100 km

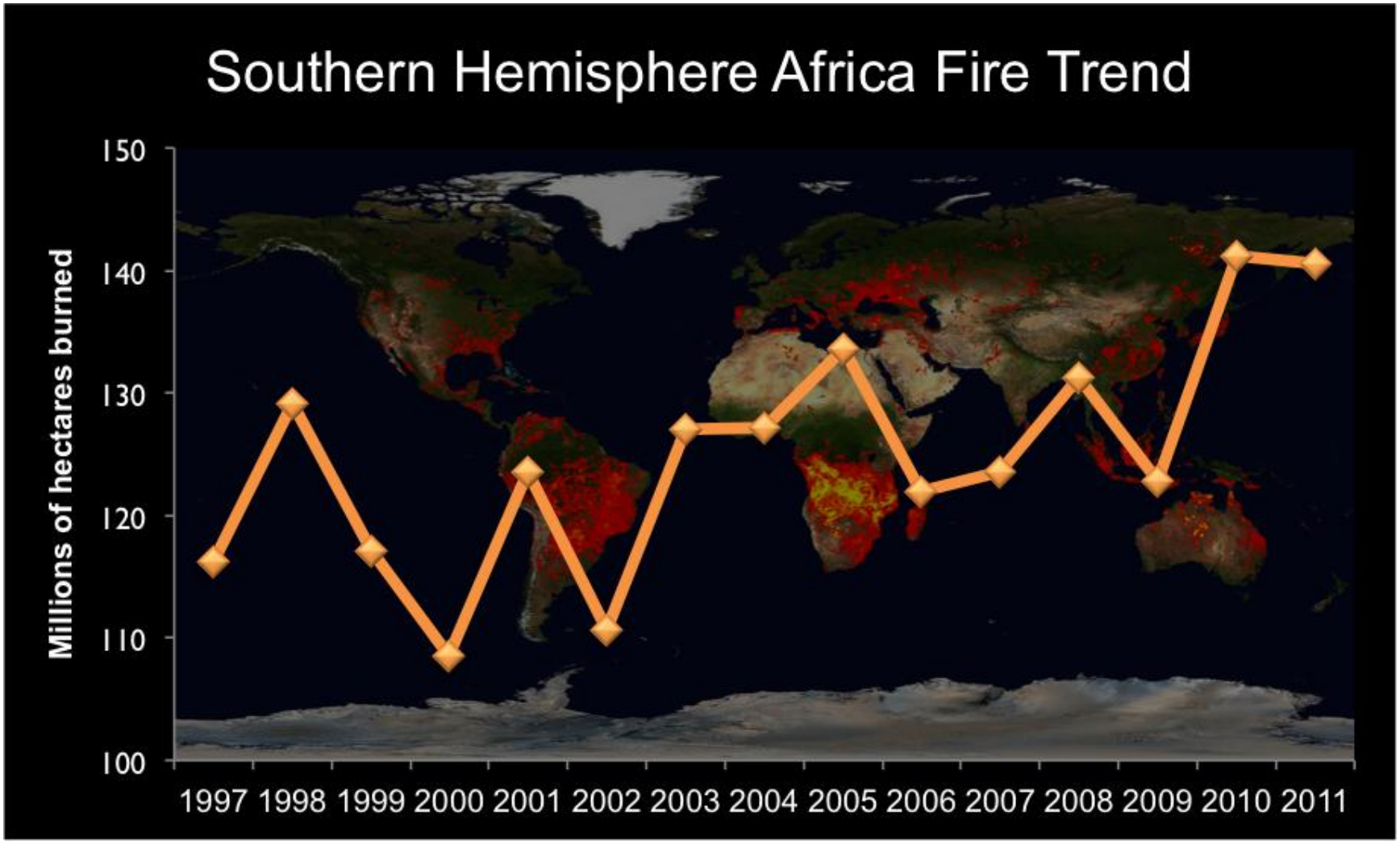

Whitewater-Baldy Fire Complex
New Mexico, 23 May 2012
25
km

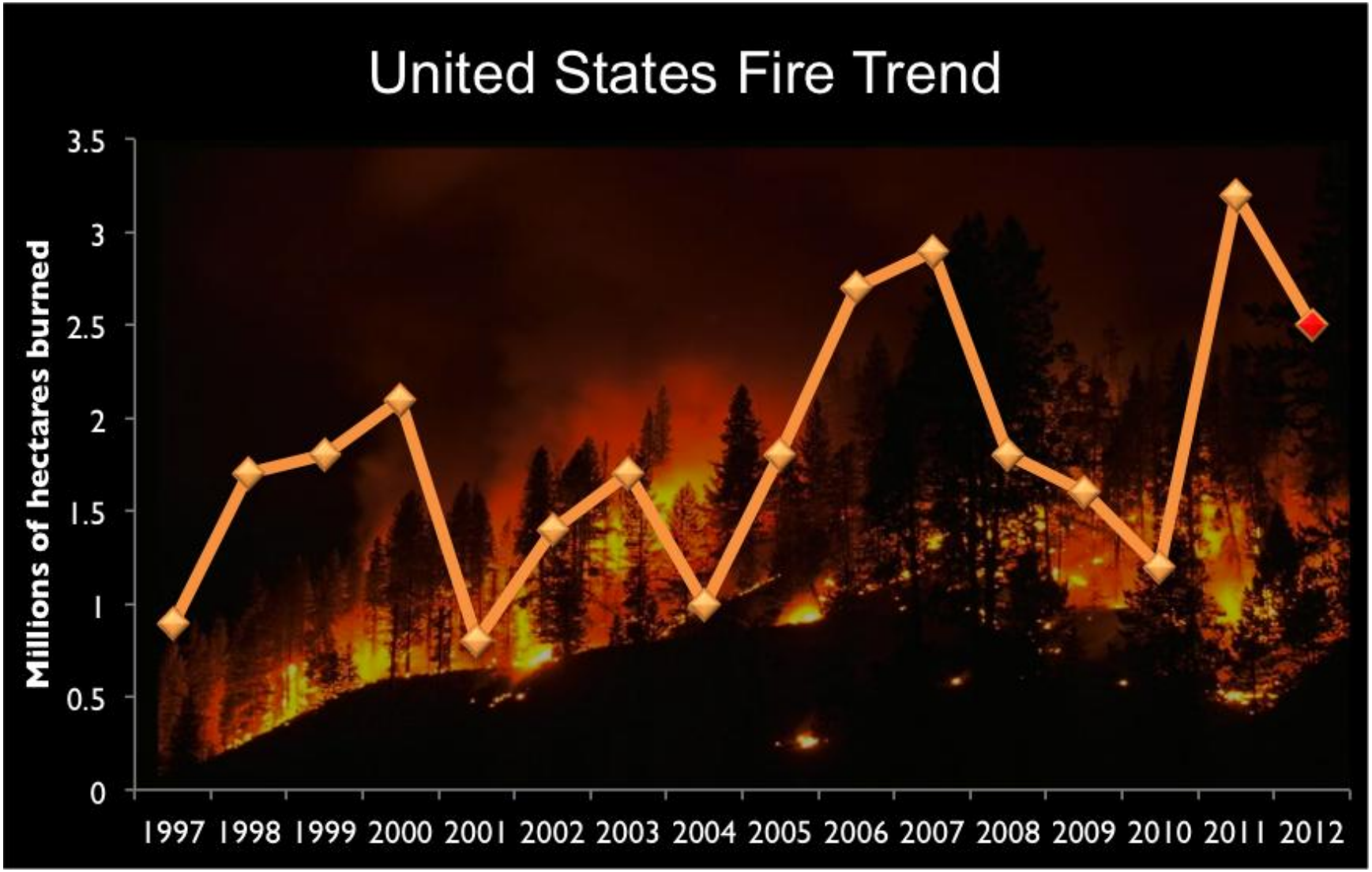


Deforestation Fires
Bolivia and Brazil, 13 Sep. 2004


Burned Area in CAR and South Sudan
2004-2005 Fire Season
10°N
5°N
500 km (311 mi)
20°E
25°E
30°E

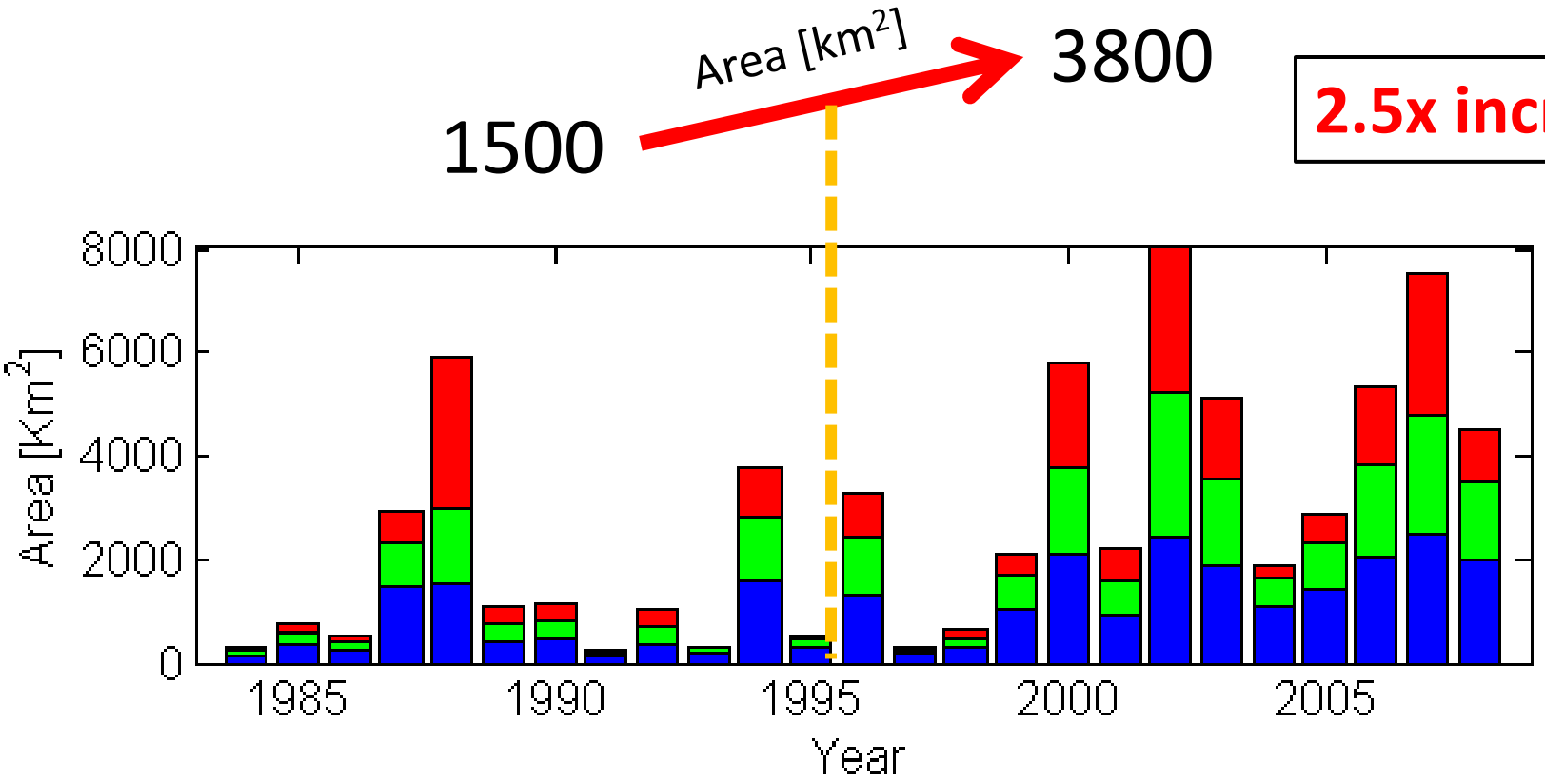
2012 U.S. MODIS Active Fires (through October)

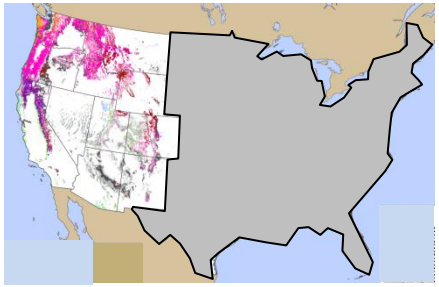

Southern Hemisphere Africa Fire Trend
Millions of hectares burned
150
140
130
120
110
100
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011



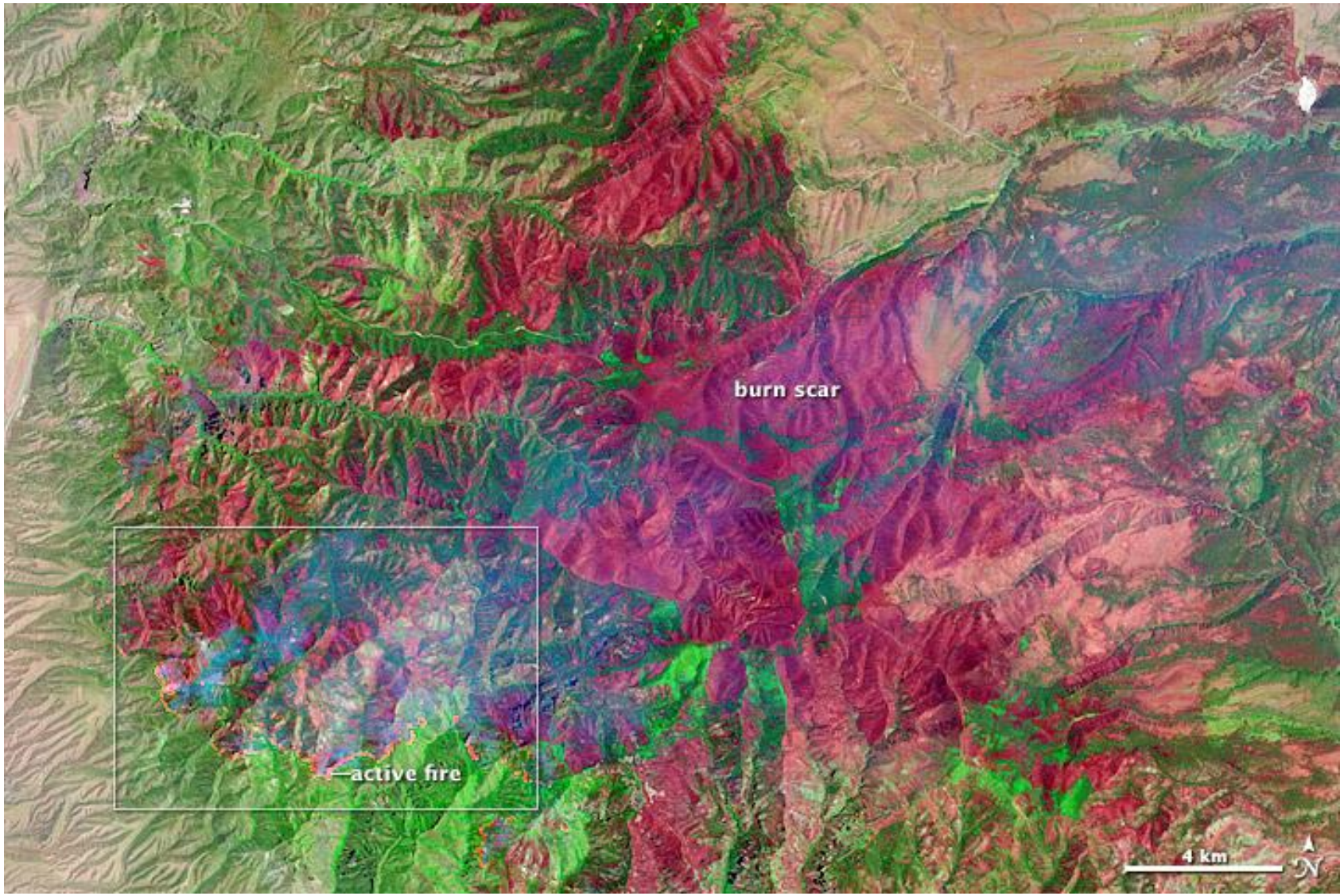
2012 total is for January – August

Large Increase in **Burned Area** across Wildlands of the Western US in Recent Decades





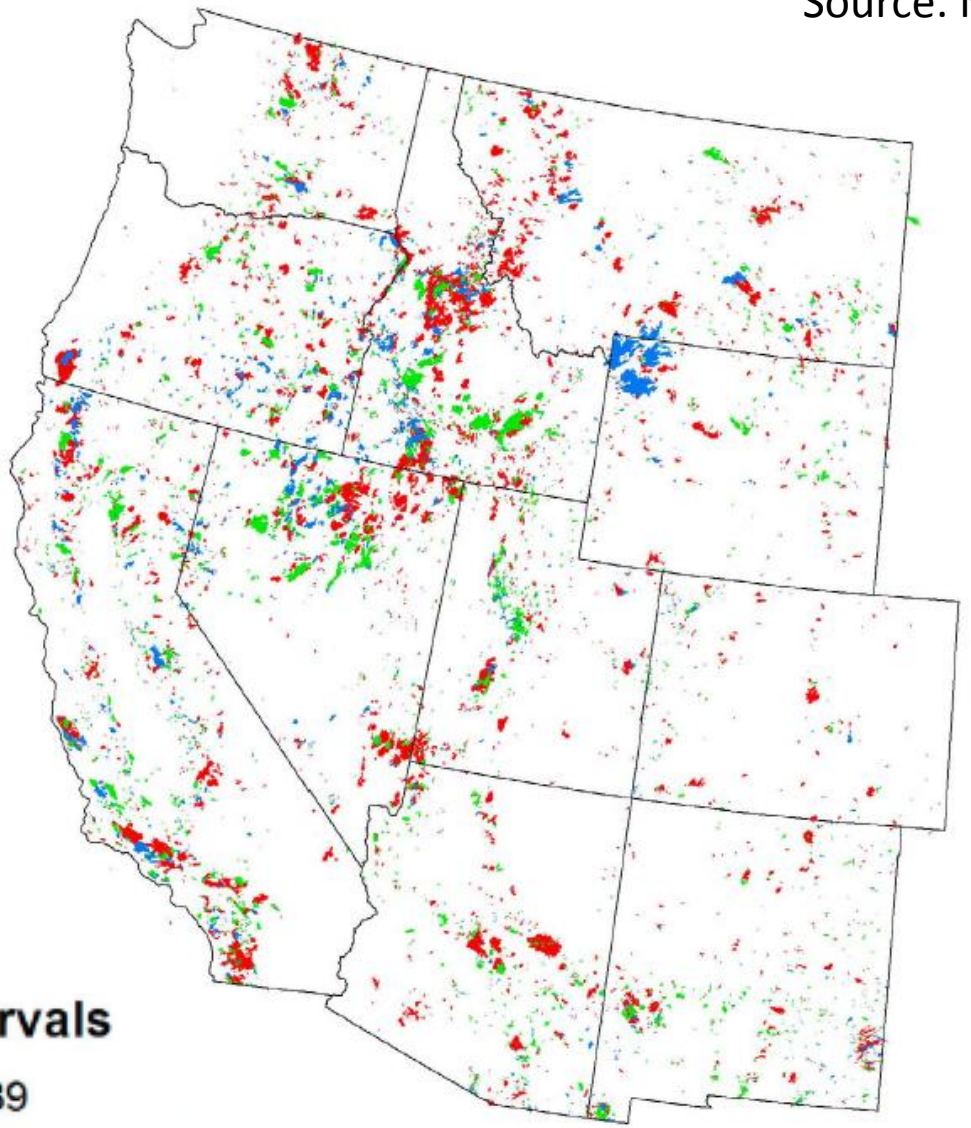
Low Severity | Medium Severity | High Severity



Sources: Image from http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=78284

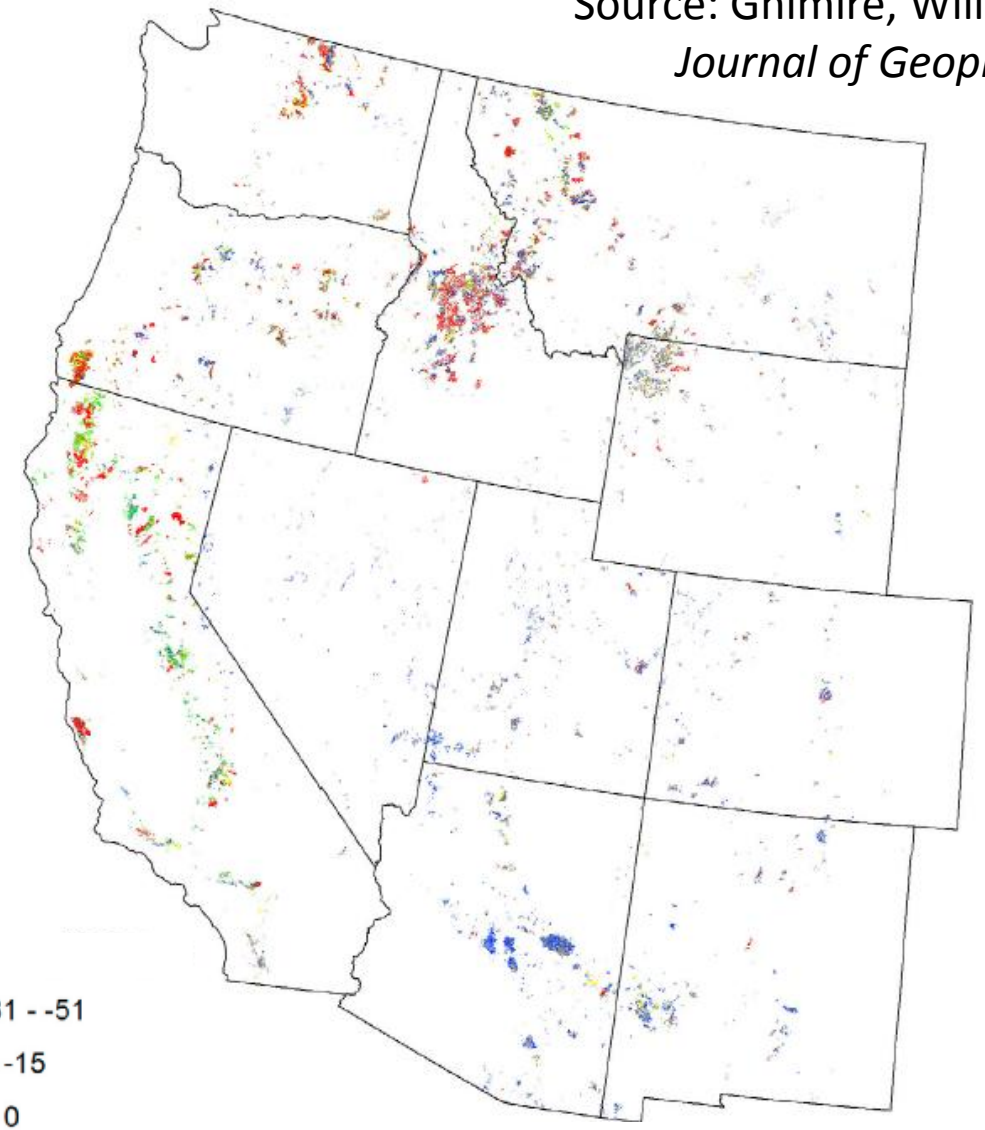
Burned Areas 1984 to 2008 (all severities)

Source: Monitoring Trends in Burn Severity
http://www.mtbs.gov/



Carbon Balance Impacts (2008)

Source: Ghimire, Williams, et al. (2012)
Journal of Geophysical Research – Biogeosciences



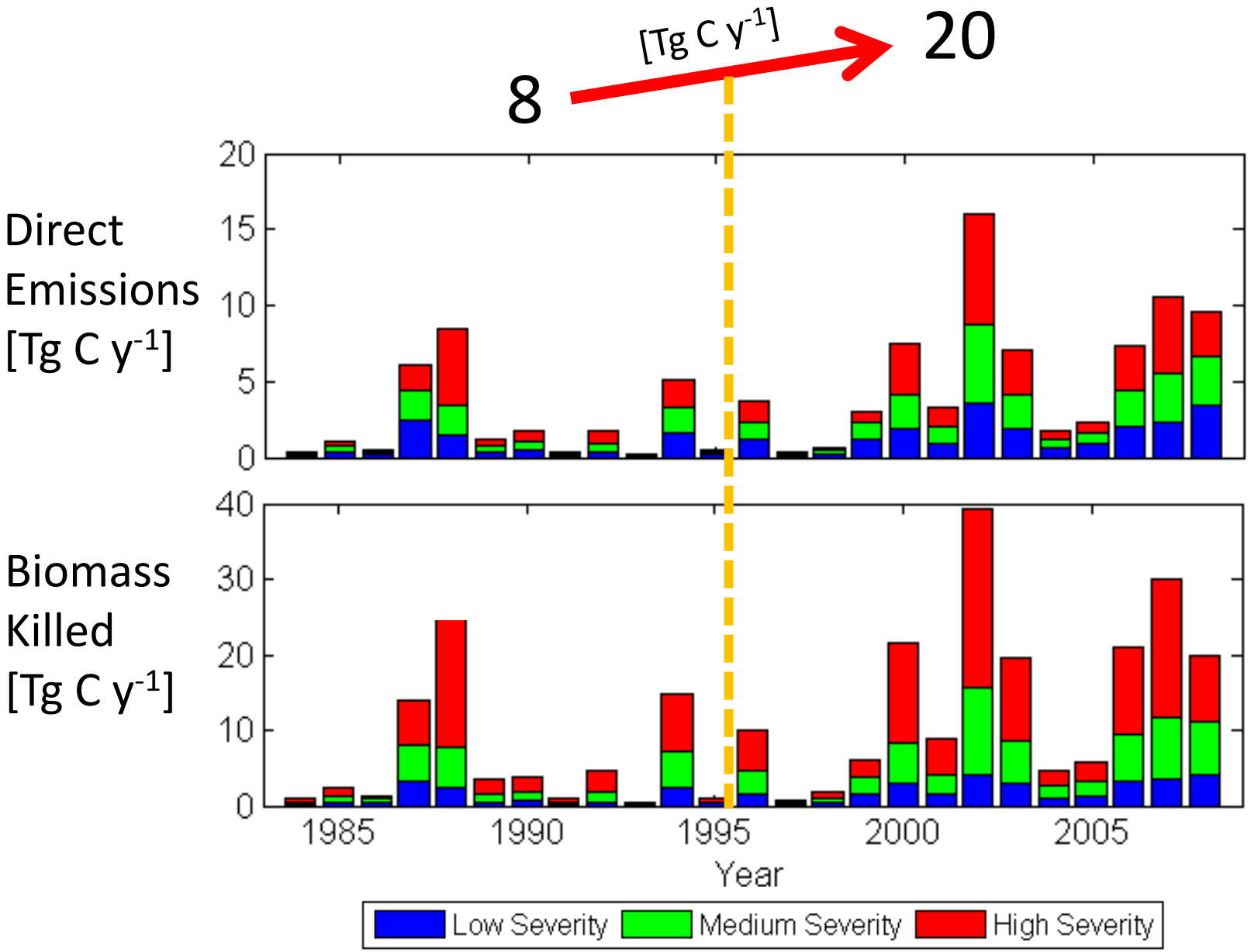
Net Carbon Emission

Net Carbon Uptake

-2,481 - -51
-51 - -15
-15 - 0
0 - 20
20 - 44
44 - 522

Net Ecosystem Productivity
[g C m^{-2} y^{-1}]

Large Increase in **Carbon Release** from Western US Wildland Fires over Recent Decades






Fires Are a Sizeable Part of Disturbed **Area**

	Western U.S. [km^2 $year^{-1}$]	Percent of Total Disturbed Area
Beetles (ADS)*	13,000	54%
Fires (MTBS)**	4,000	17%
Harvest (USFS)***	7,000	29%
Total Disturbed	24,000	100%
Total Forested	840,000	--

*Ghimire et al. *in review*, **Ghimire et al. JGR-B 2012, ***Williams et al. GBC 2012




Fires are an Even Larger Part of **Carbon Impacts**† Across Major Disturbance Types

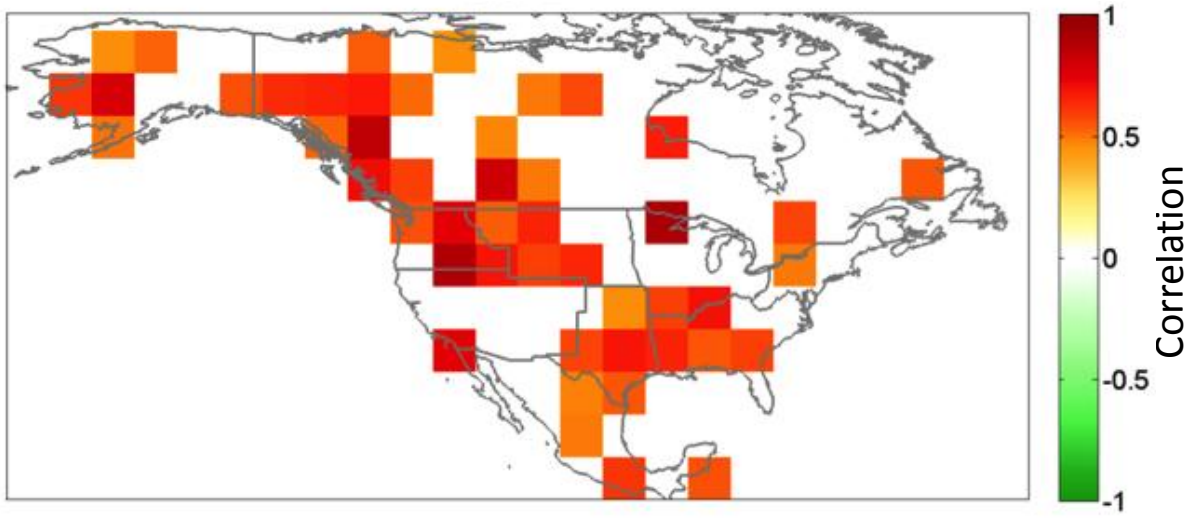
	Western U.S. [Tg C year^{-1}]	Percent of Total Disturbed Area
Beetles (ADS)*	7 to 15	16%
Fires (MTBS)**	20 to 25	33%
Harvest (USFS)***	30 to 40	51%
Total Disturbed	57 to 80	100%

†Carbon from disturbance-killed biomass including combustion, live to dead transfers, and removals

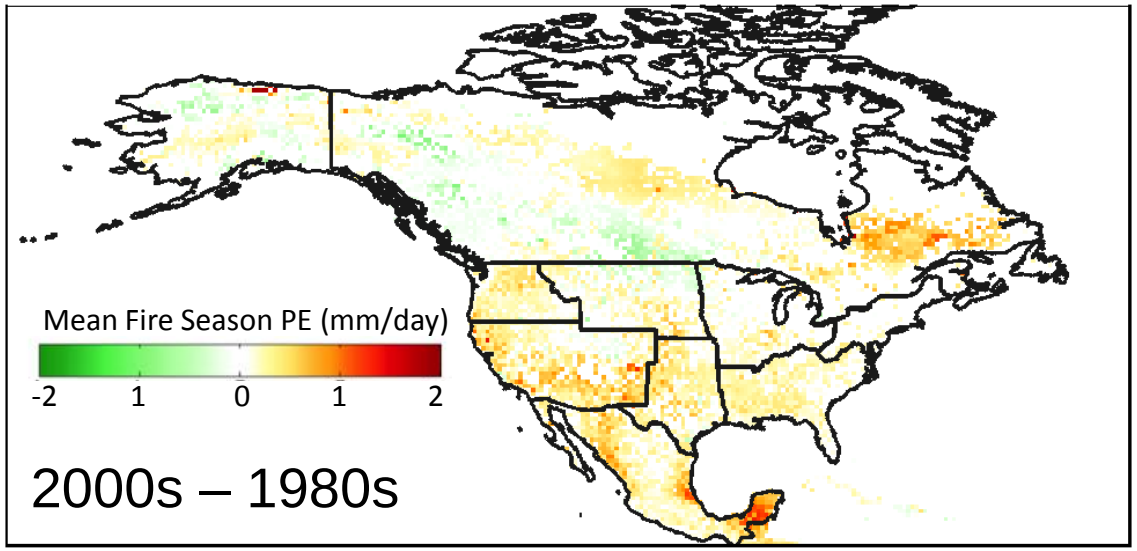
*Ghimire et al. *in review*, **Ghimire et al. JGR-B 2012, ***Williams et al. GBC 2012


High Park Wildfire, west of Fort Collins, CO
Arapaho and Roosevelt National Forests
June 10, 2012

Interannual variability in US burned area is strongly correlated with potential evaporation (PE), a measure of dryness during the fire season:



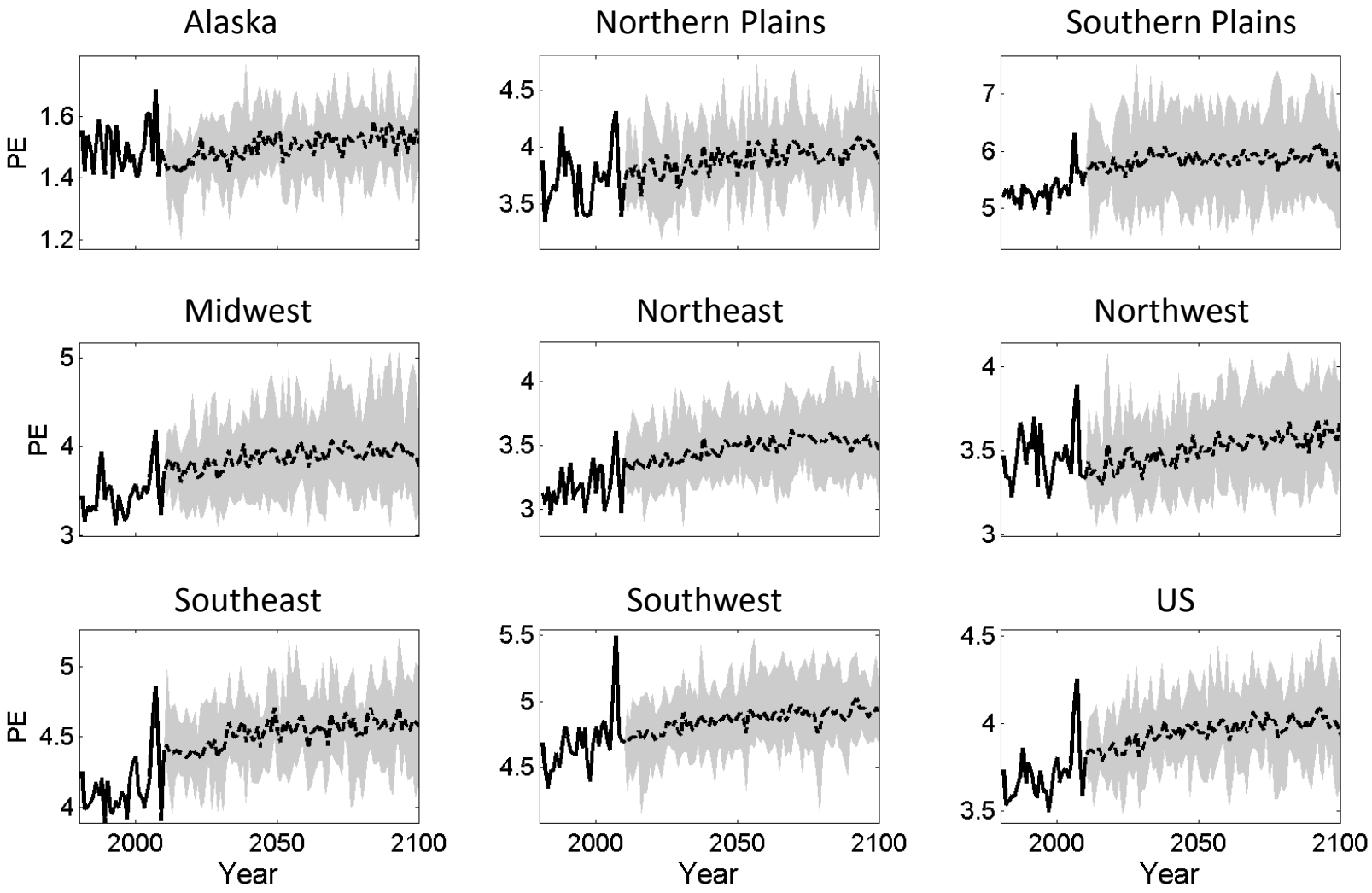
Dryness during the fire season and burned area have both increased between 1980 and 2010:



Morton *et al.*, 2012

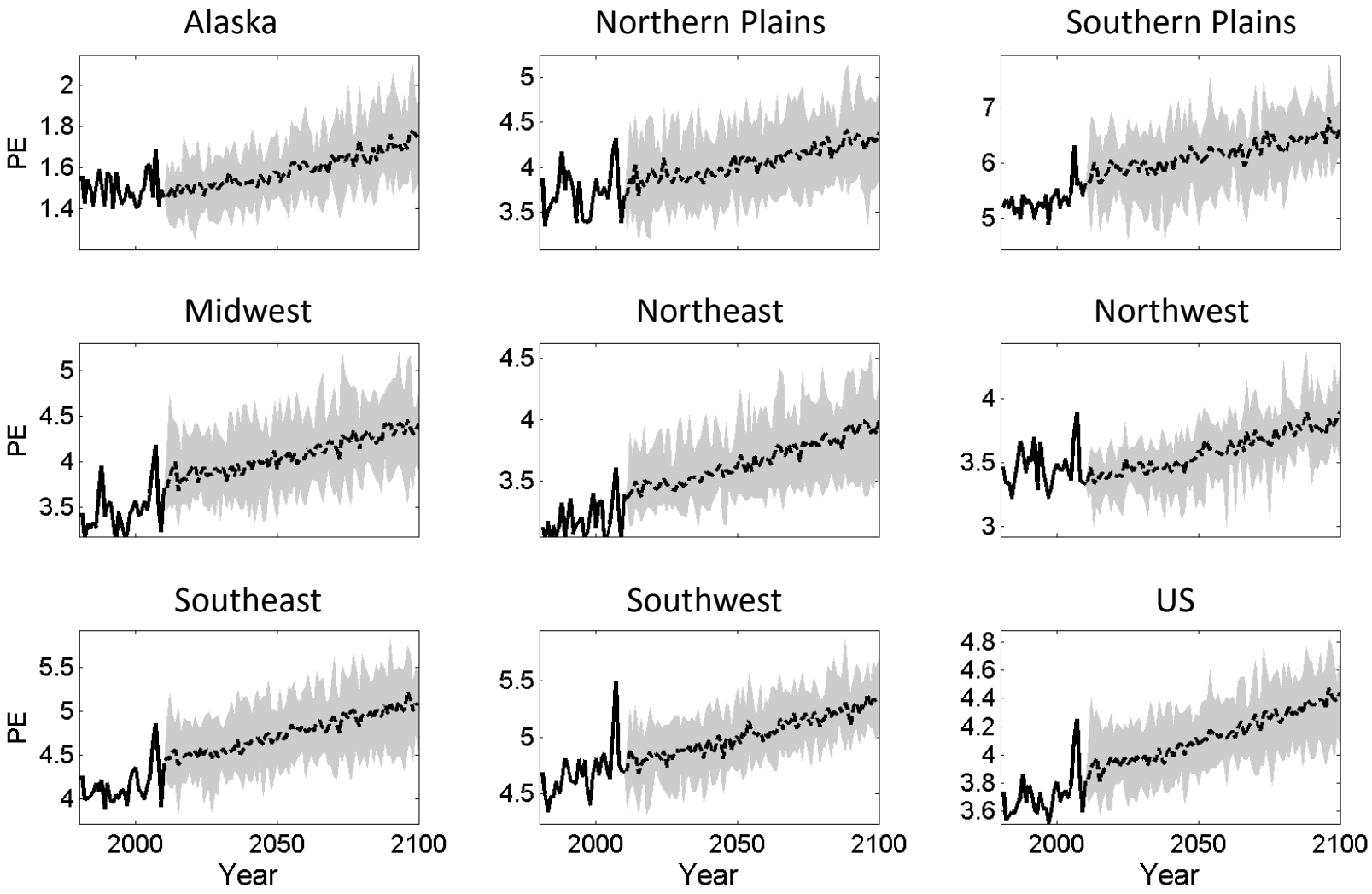
Projected increase in dryness: middle emissions scenario

RCP 4.5



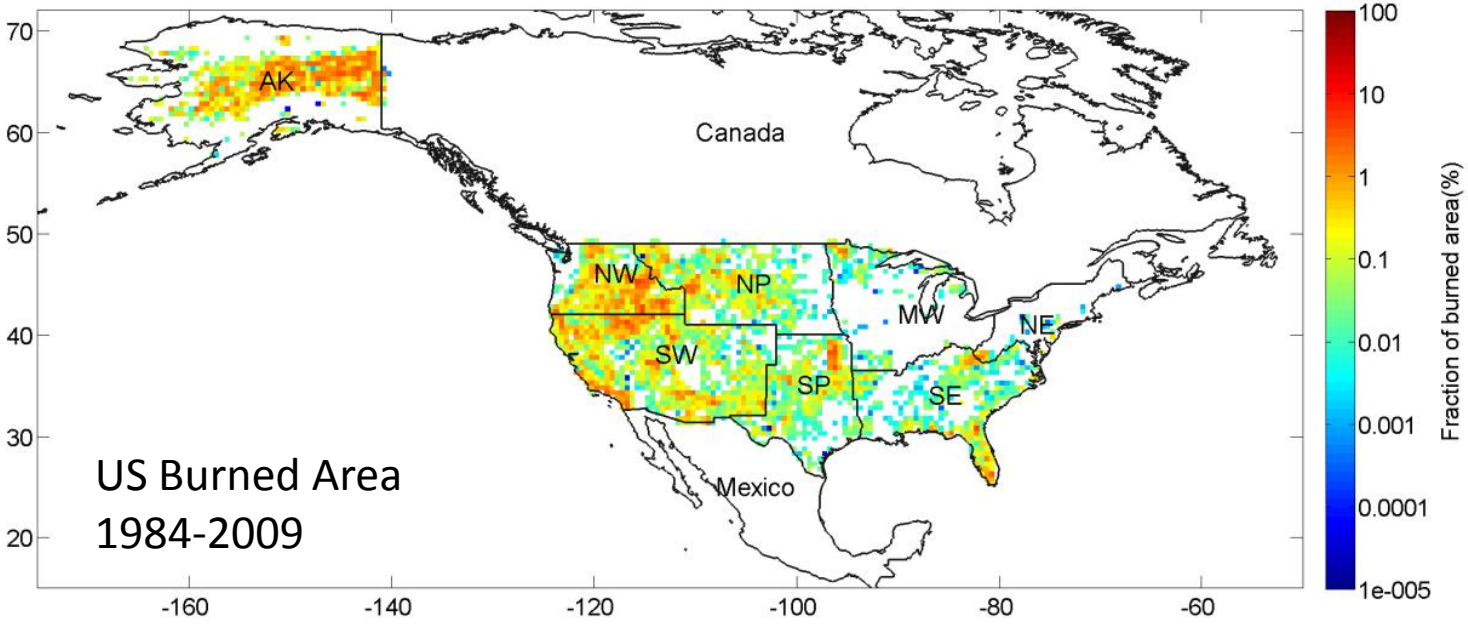
Projected increase in dryness: high emissions scenario

RCP 8.5

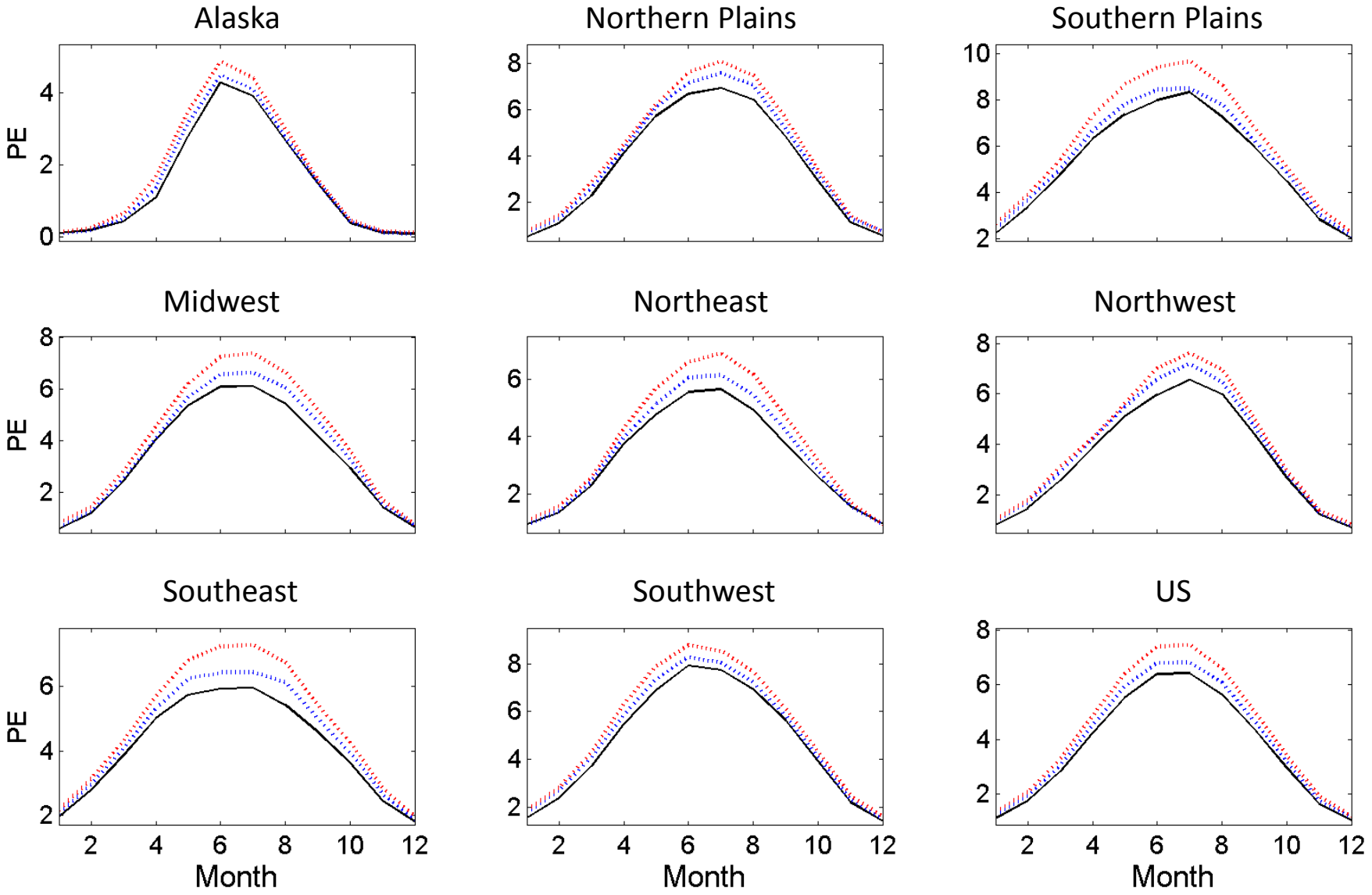


Drier conditions by mid-century increase projected burned area under middle and high emissions scenarios:

	Alaska	No. Plains	So. Plains	Midwest	Northwest	Southeast	Southwest	US
RCP 4.5	13%	73%	264%	125%	19%	135%	34%	78%
RCP 8.5	101%	117%	407%	164%	44%	202%	61%	125%

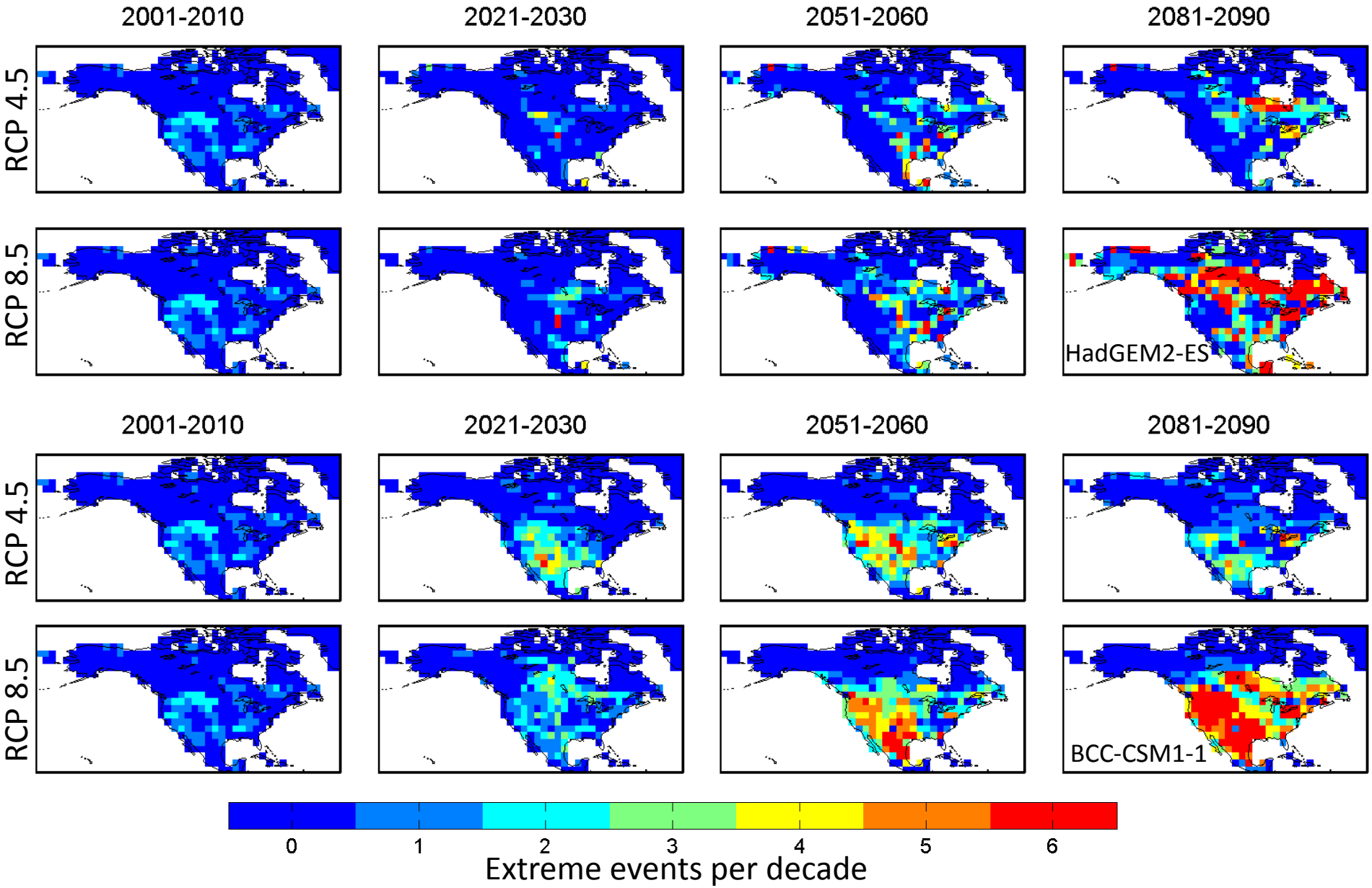


Climate projections suggest a longer, stronger fire season by 2100:



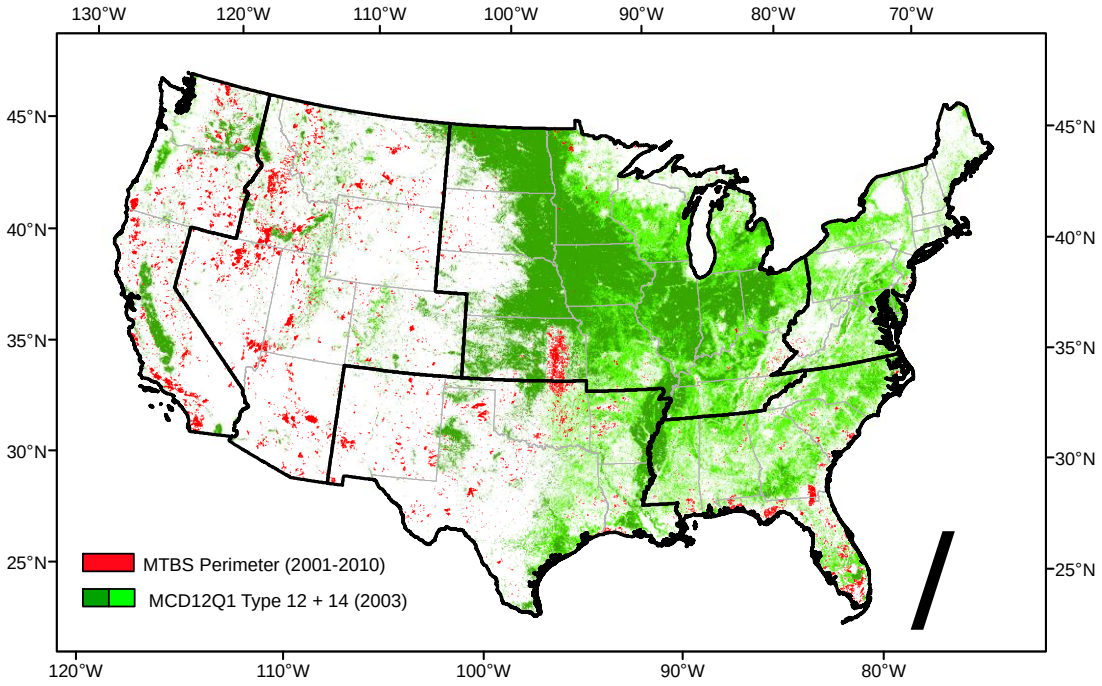
Black: Historic Observations, Blue: RCP4.5, Red: RCP8.5

Most models suggest an increase in the frequency of extreme events:



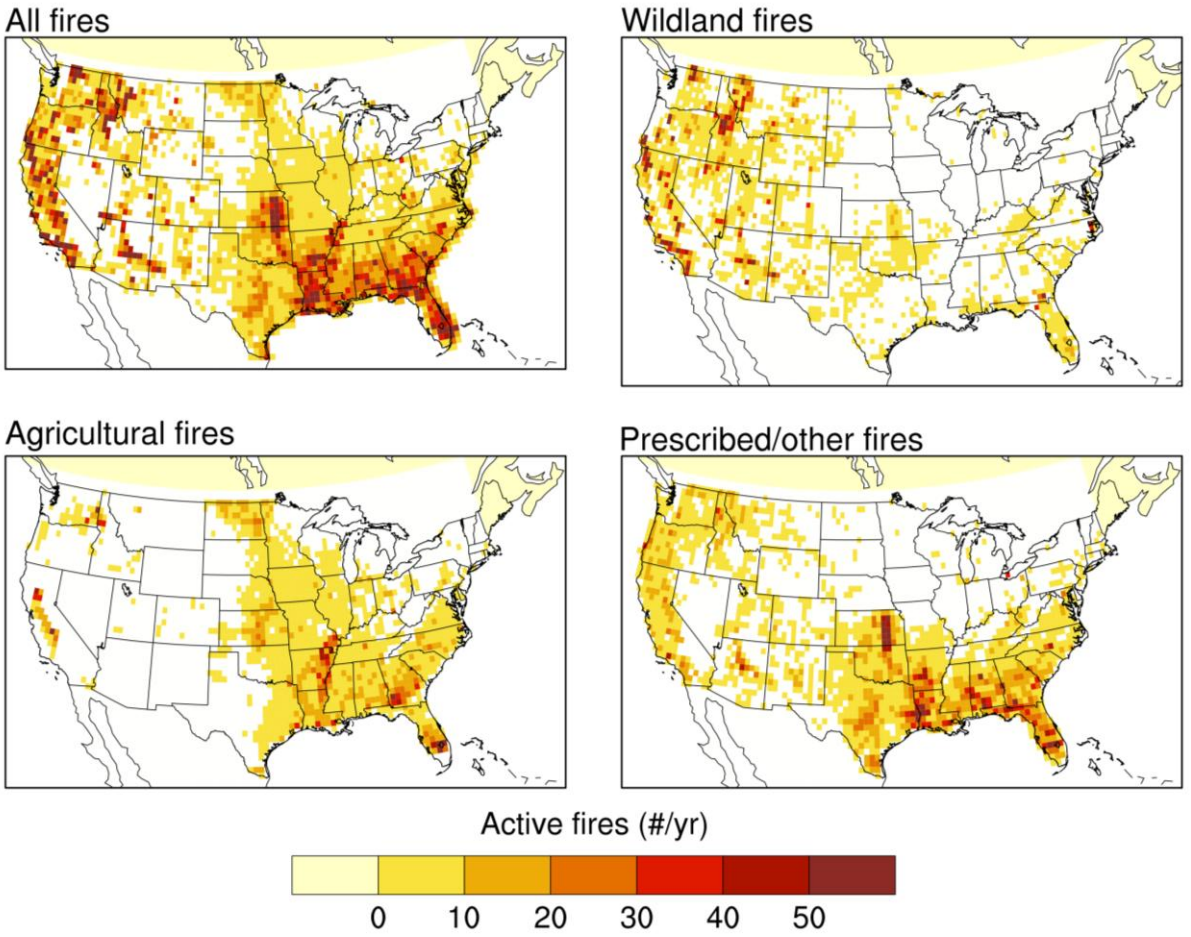
Associate active fire with three management types, and quantify decadal trends (2001-2010), interannual variability, seasonality, and climate sensitivity:

1. Wildland fires
2. Agricultural fires (in croplands)
3. Prescribed/other fires (in plantations, grasslands, rangelands, or other)

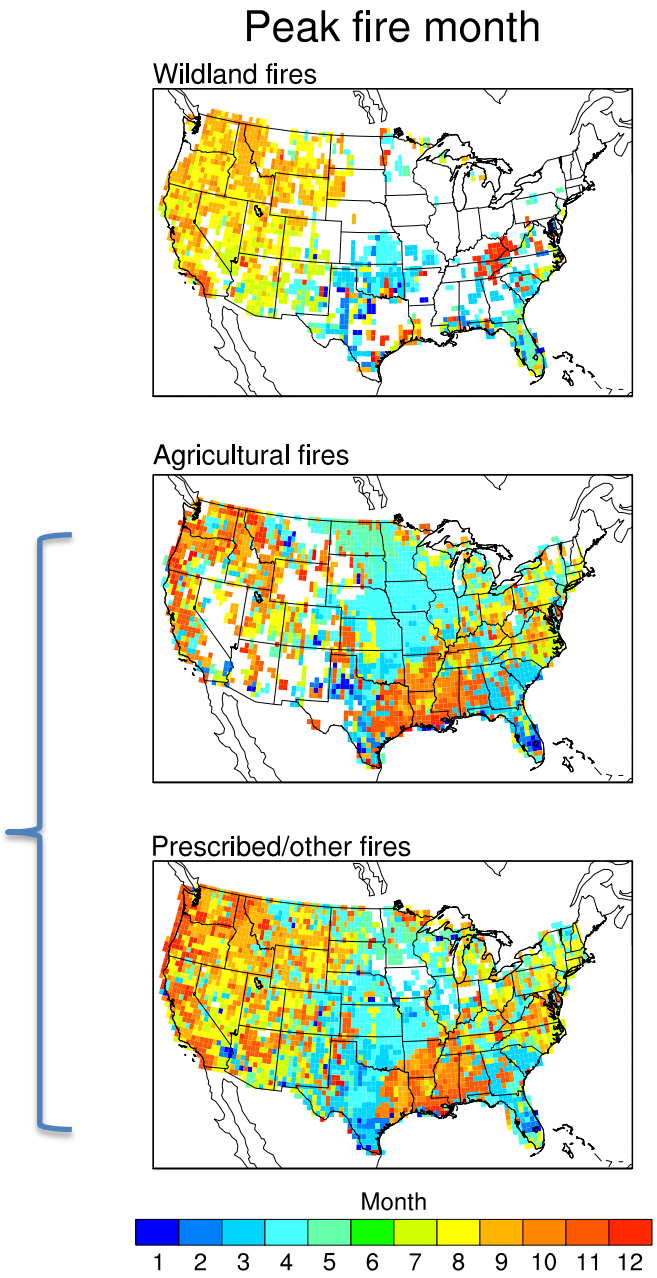


MTBS: Monitoring Trends in Burn Severity
http://mtbs.gov

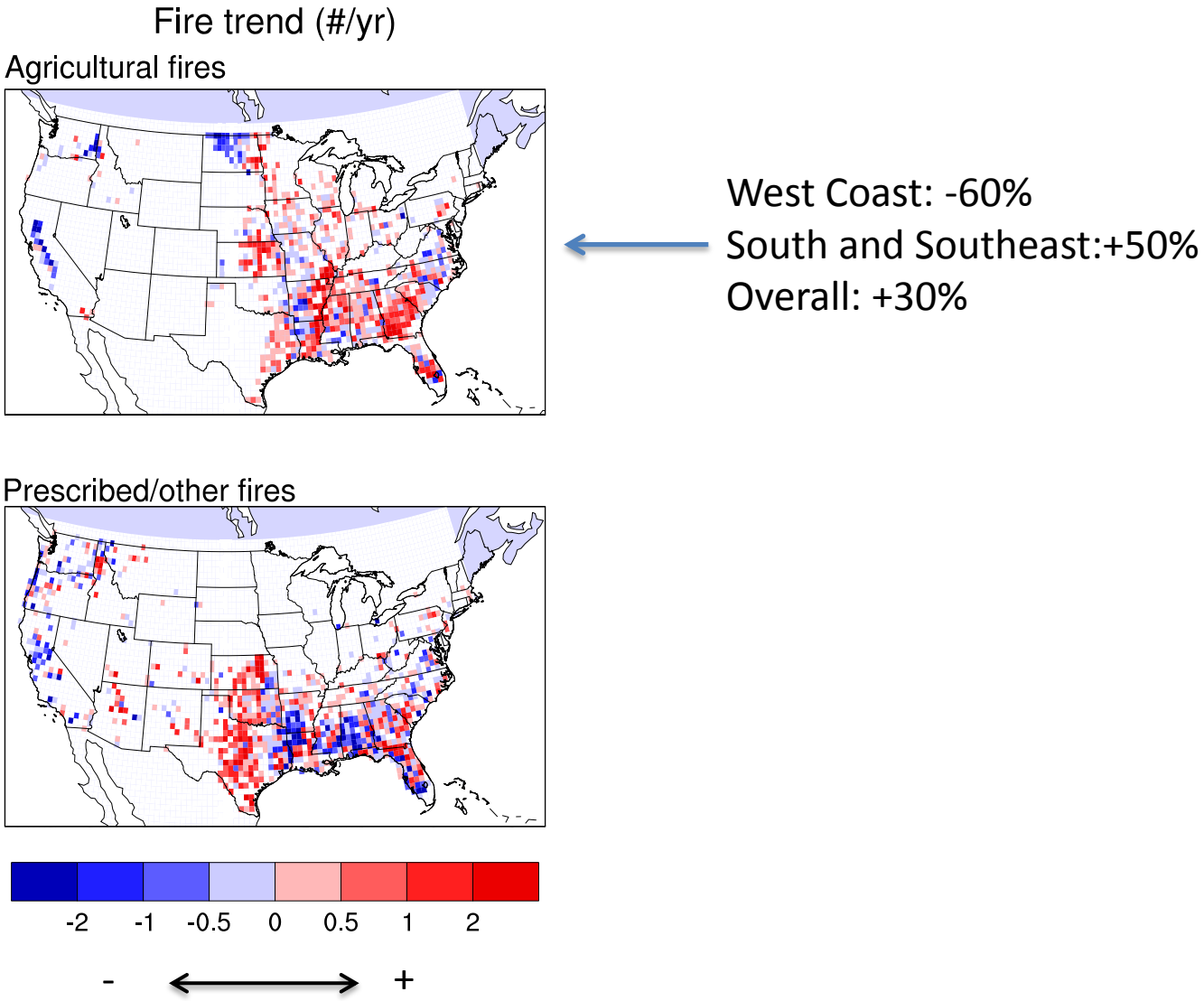
Agricultural and prescribed fires account for 70% of total active fires in continental US



Agricultural and perscribed fires have distinctive seasonal patterns that come later in the year



Agricultural fires have increased by 30% over the last decade in the continental US

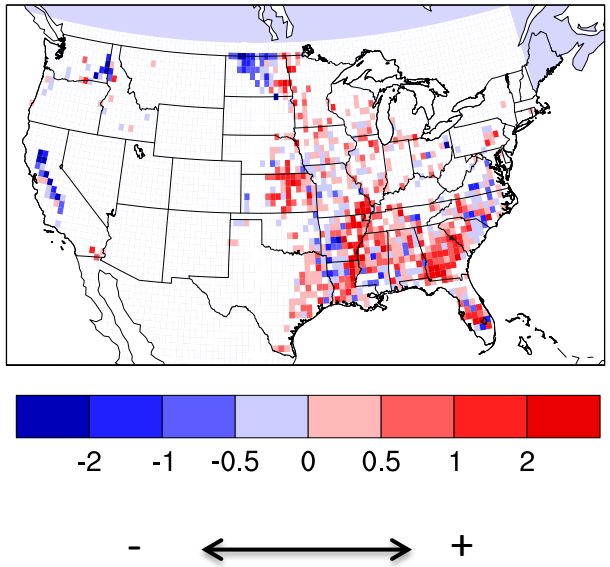


West Coast: -60%
South and Southeast:+50%
Overall: +30%

Agricultural fires have increased by 30% over the last decade in the continental US…yet are less sensitive to dryness

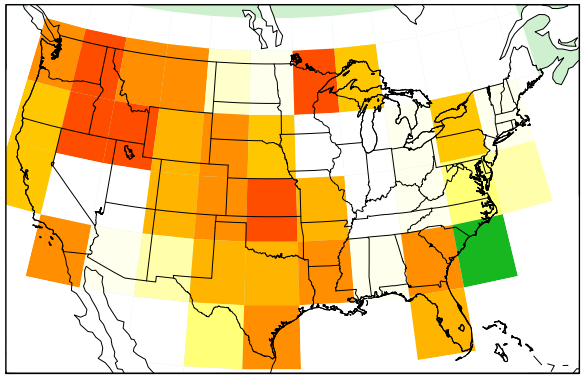
Fire trend (#/yr)

Agricultural fires

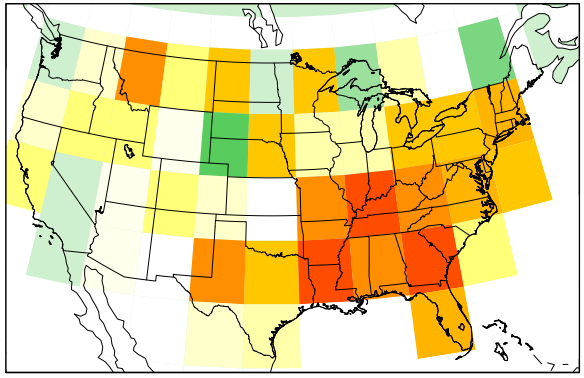


Correlation between PE and active fires

Wildland fires



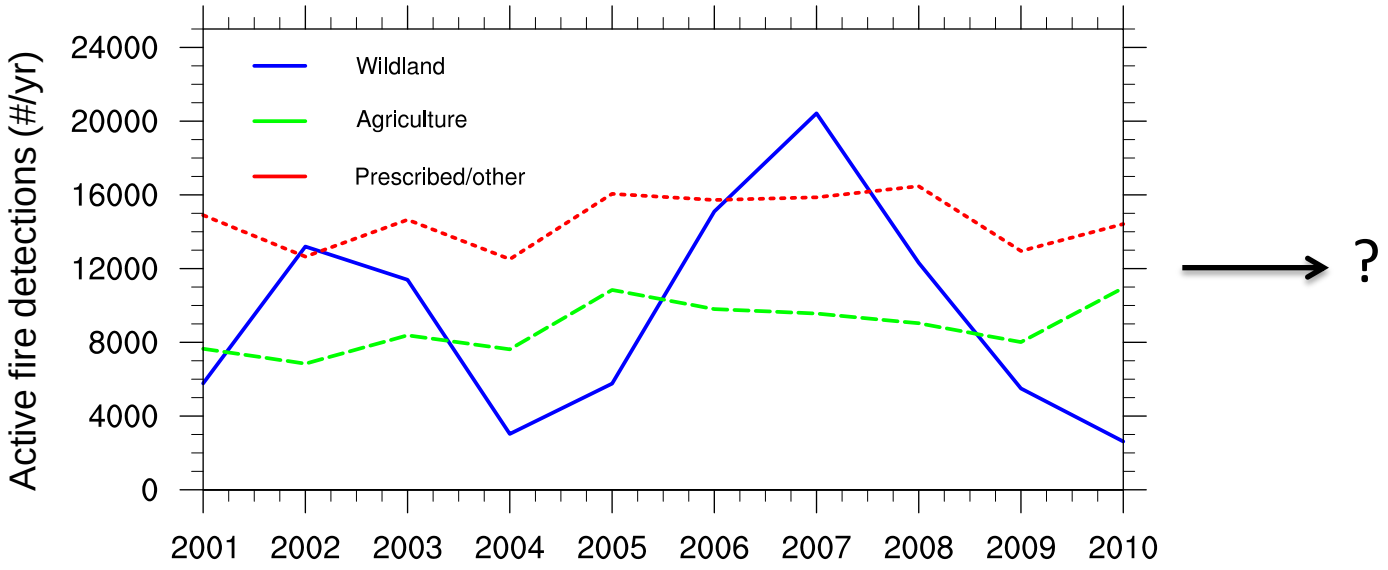
Agricultural fires



PE: Potential Evaporation

Conclusions

- Approximately 70% of active fire detections in the US are due to management
- There is a 30% overall increase in agricultural fires in the last decade
- Climate plays a smaller role in driving these fires than it does with wildland fires
- There is potential to control fire emissions by regulating these fires with a careful cost benefit analysis



2012 U.S. Fire Season (through October)

For images and additional information on this research, visit:
http://go.usa.gov/gKsx